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IS : 9000 (Part V/Sec 1 & 2) - 1981

Indian Standard

BASIC ENVIRONMENTAL TESTING
PROCEDURES FOR ELECTRONIC
AND ELECTRICAL ITEMS

PART V DAMP HEAT (CYCLIC) TEST

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BUREAU OF INDIAN STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG

NEW DELHI 110002

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Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART V DAMP HEAT (CYCLIC) TEST

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Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART V DAMP HEAT (CYCLIC) TEST

0. F O R E W O R D

0.1 This Indian Standard (Part V/Sec 1 & 2) was adopted by the Indian Standards Institution on 19 June 1981, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The differences in environmental testing procedures for component type items and equipment type items are fast disappearing in the context of technological developments. It is, therefore, felt necessary to have uniform testing procedures, wherever possible. This series of standards on environmental testing procedures (IS : 9000) has been prepared with this objective. This is also in line with the principle adopted by IEC/TC 50 'Environmental Testing' in developing unified series of standards on environmental testing procedures by the International Electrotechnical Commission.

0.2.1 It is proposed to withdraw the existing Indian Standards, namely, IS : 589-1961* and IS : 2106† series dealing with environmental tests for electronic components and equipment respectively, as soon as the tests mentioned therein are covered in the new series (IS : 9000).

0.3 This standard covers damp heat test procedures to determine the suitability of electronic and electrical items for use and storage under conditions of high relative humidity when combined with cyclic temperature changes.

0.3.1 This test also acts as a rapid or quick check that items have been processed and manufactured correctly.

0.3.2 The items subjected to this test shall not be the same as the items subjected to damp heat (steady state) test [see IS : 9000 (Part IV)-1979‡].

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (revised).

†Environmental tests for electronic and electrical equipment.

‡Basic environmental testing procedures for electronic and electrical items: Part IV Damp heat (steady state).

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0.4 This standard (Part V/Sec 1 & 2) covers test procedure for damp heat (cyclic) test. The guidance details for damp heat tests are covered in IS : 9001 (Part IV)-1979*.

0.5 The general information on basic environmental testing procedures for electronic and electrical items is covered in IS : 9000 (Part I)-1977† and is a necessary adjunct to this standard which gives details of the procedures for damp heat (cyclic) test.

0.6 In the preparation of this standard, considerable assistance has been derived from the following:

IEC Pub 68-2-30 (1980) Basic environmental testing procedures: Part 2 Tests—Test Db and guidance: Damp heat, cyclic (12+12 hour cycle). International Electrotechnical Commission.

JSS 50101-1972 Environmental test methods for service electronic components. Directorate of Standardization, Ministry of Defence, India.

JSS 55555-1977 Environmental test methods for electronic and electrical equipment. Directorate of Standardization. Ministry of Defence, India.

0.7 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960‡.

*Guidance for environmental testing: Part IV Damp heat tests.

†Basic environmental testing procedures for electronic and electrical items: Part I General.

‡Rules for rounding off numerical values (*revised*).

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART V DAMP HEAT (CYCLIC) TEST

Section 1 16 + 8 h Cycle

1. SCOPE

1.1 This standard (Part V/Sec 1) gives the procedure for application of high relative humidity combined with wide temperature changes on electronic and electrical items as a part of the basic environmental testing procedures.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part I)-1977* shall apply.

3. OBJECT

3.1 The object of this test is to determine the suitability of equipment type items for use and storage under conditions of high relative humidity when combined with cyclic temperature changes.

4. TESTING CHAMBER

4.0 General — The chamber shall be so constructed that the conditions given in 4.1 to 4.7 may be obtained [*see also* IS : 9000 (Part III)-1977†].

4.1 The temperature can be varied cyclically between the laboratory temperature $25 \pm 10^{\circ}\text{C}$ and $40 \pm 2^{\circ}$ in $2\frac{1}{2}$ h with the rate of change specified in 6.2 and Fig. 1.

4.2 The relative humidity can be maintained at not less than 95 percent during the period of high temperature and not less than 80 percent during rest of the cycle.

4.3 Condensed water shall be continuously drained from the chamber and shall not be used again until it has been re-purified.

*Basic environmental testing procedures for electronic and electrical items: Part I General.

†Basic environmental testing procedures for electronic and electrical items: Part III Dry heat test.

4.4 Water used for the maintenance of chamber humidity shall have a resistivity of not less than 500 ohm metre.

4.5 Condensed water from the walls and roof of the chamber shall not fall on the items.

4.6 The items under test shall not be subjected to radiant heat from the chamber conditioning processes.

4.7 The dimensions, properties and/or electrical loading of the items under test shall not appreciably influence conditions within the chamber.

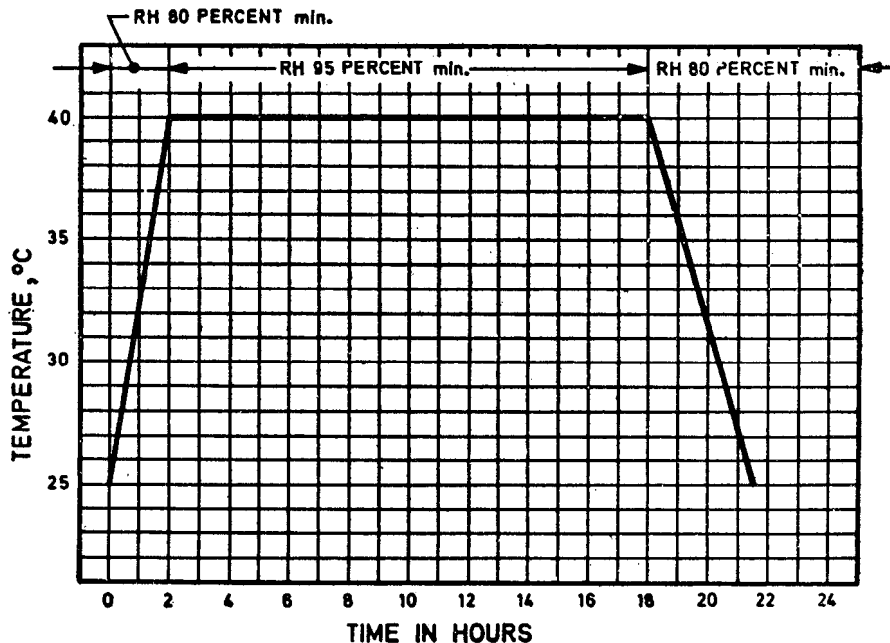


FIG. 1 DAMP HEAT CYCLIC TEST

5. INITIAL MEASUREMENTS

5.1 The items shall be visually inspected and electrically and mechanically checked, as required by the relevant specification.

6. CONDITIONING

6.1 The items shall be introduced into the chamber in the unpacked, switched off, ready for use state or as otherwise specified in the relevant specification.

6.2 The chamber temperature shall be raised from laboratory temperature $25 \pm 10^{\circ}\text{C}$ to $40 \pm 2^{\circ}\text{C}$ within a period of $2 \text{ h} \pm 30 \text{ min}$; the relative humidity during this period shall be not less than 80 percent and condensation on the item shall occur.

6.3 The chamber temperature shall be maintained at $40 \pm 2^{\circ}\text{C}$ for a period of 16 h. During this period the relative humidity shall be not less than 95 percent.

6.4 During the last 30 min of the 16 h period, the item shall be operated and a performance check as specified (*see 7.1*) shall be carried out.

6.5 The temperature within the chamber shall then be allowed to cool to laboratory temperature in not less than 1 h. The relative humidity during this cooling period shall be not less than 80 percent. The chamber temperature shall be maintained at the laboratory temperature and at relative humidity not less than 80 percent for the remainder period of the 24 h from the start of the test. However, this period shall be at least 3 h.

6.6 The graphical description of the test cycle is given in Fig. 1.

7. INTERMEDIATE MEASUREMENTS

7.1 In order to assess the performance of items, the relevant specification may require electrical and/or mechanical checks during the conditioning (*see 6.4*). These shall be carried out as specified in the relevant specification. The relevant specification may also specify the loading of component type items and the period for which it shall be applicable.

NOTE — Measurements preceded by recovery which would require removal of items from the chamber are not permissible during conditioning.

8. RECOVERY

8.1 After removal from the chamber, the surface moisture on the items shall be removed. This may be by means of shaking or any other method recommended in the relevant specification.

8.2 The item shall then remain under standard atmospheric conditions for recovery for not less than 1 h nor more than 2 h.

9. FINAL MEASUREMENTS

9.1 The items shall be visually inspected and electrically and mechanically checked as required by the relevant specification.

10. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

10.1 Where this test is included in the relevant specification, the following details shall be given as far as they are applicable:

<i>Details</i>	<i>Clause Ref</i>
a) Preconditioning	—
b) Initial measurements	5
c) Loading during conditioning	6.1
d) Intermediate measurements	7
e) Method of removal of surface moisture	8.1
f) Final measurements	9
g) Any deviation from the test procedure	—

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART V DAMP HEAT (CYCLIC) TEST

Section 2 12 + 12 h Cycle

1. SCOPE

1.1 This standard (Part V/Sec 2) deals with procedure for application of high relative humidity combined with cyclic temperature changes on electronic and electrical items as a part of the basic environmental testing procedures.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part I)-1977* shall apply.

3. OBJECT

3.1 The object of this standard is to determine the suitability of components, equipment or other articles for use and storage under conditions of high humidity when combined with cyclic temperature changes and, in general, producing condensation on the surface of the item.

4. TESTING CHAMBER

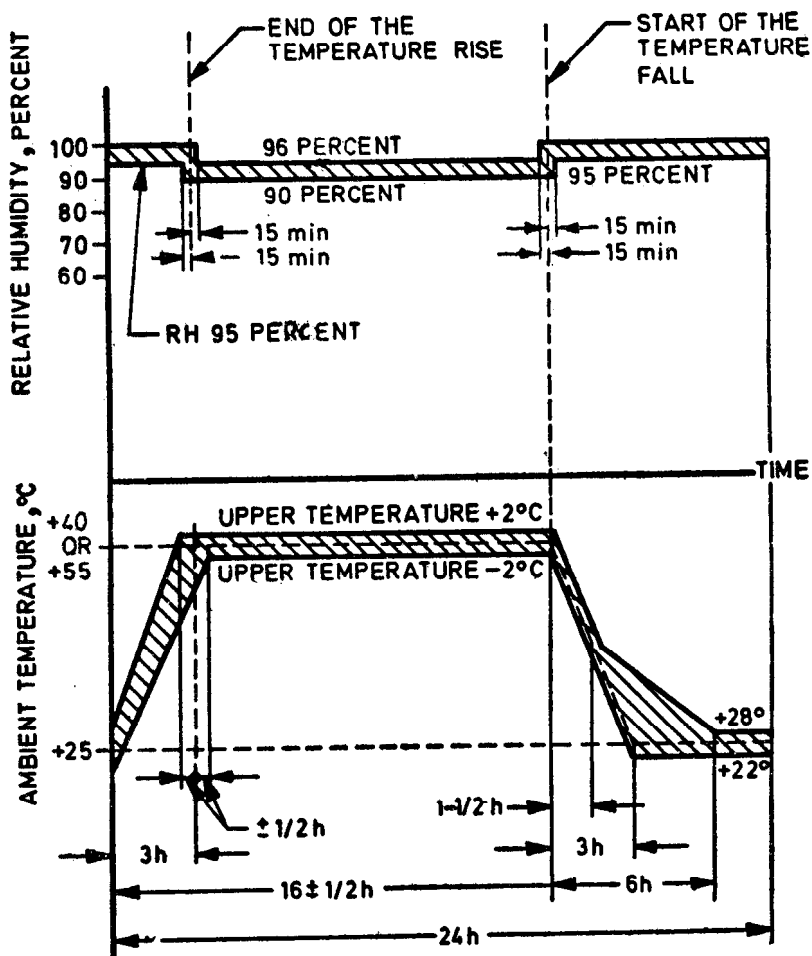
4.0 General — The chamber shall be so constructed that the condition given in 4.1 to 4.7 may be obtained [*see also* IS : 9000 (Part III)-1977†].

4.1 The temperature can be varied cyclically between $25 \pm 3^{\circ}\text{C}$ and the appropriate upper temperature specified with the tolerance and rate of change specified in 7.3 and Fig. 1A or 1B, as applicable.

4.2 The relative humidity in the working space can be maintained within the limits given in 7.3 and Fig. 1A or 1B as applicable.

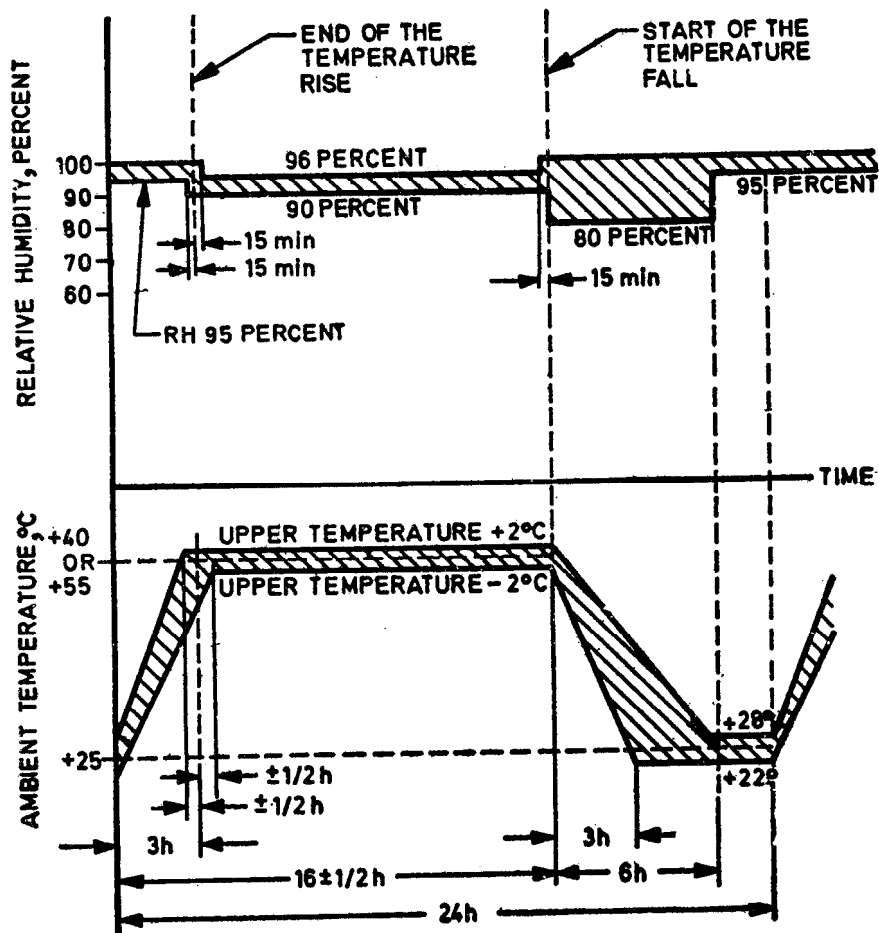
*Basic environmental testing procedures for electronic and electrical items: Part I General.

†Basic environmental testing procedures for electronic and electrical items: Part III Dry heat test.



1A Test Cycle — Variant 1

FIG. 1 DAMP HEAT CYCLIC TEST — *Continued*



1B Test Cycle — Variant 2
FIG. 1 DAMP HEAT CYCLIC TEST

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4.3 Condensed water shall be continuously drained from the chamber and shall not be used again until it has been re-purified.

4.4 Water used for the maintenance of chamber humidity shall have a resistivity of not less than 500 ohm metre.

4.5 Condensed water from the walls and roof of the chamber shall not fall on the items.

4.6 The items under test shall not be subjected to radiant heat from the chamber conditioning processes.

4.7 The dimensions, properties and/or electrical loading of the items under test shall not appreciably influence conditions within the chamber.

5. SEVERITIES

5.1 The severity of the test is defined by the combination of the upper temperature and the number of cycles.

5.2 The severity shall be chosen from the following:

- | | | |
|----------------------|---|------------------|
| a) Upper temperature | : | 40°C |
| Number of cycles | : | 2, 6, 12, 21, 56 |
| b) Upper temperature | : | 55°C |
| Number of cycles | : | 1, 2, 6 |

6. INITIAL MEASUREMENTS

6.1 The items shall be visually inspected and electrically and mechanically checked, as required by the relevant specification.

7. CONDITIONING

7.1 The item shall be introduced into the chamber either in the unpacked, switched off, ready-for-use state, or as otherwise specified in the relevant specification.

Where no specific mounting is prescribed, the thermal conduction of the mounting shall be low such that for all practical purposes the item is thermally isolated.

7.2 Stabilizing Period — The temperature of the items shall be stabilized at $25 \pm 3^\circ\text{C}$. During this period, the relative humidity shall be maintained as given in Fig. 2:

- a) either by placing the items in a separate chamber before introducing it into the test chamber, or

- b) by adjusting the temperature of the test chamber to $25 \pm 3^\circ\text{C}$ after the introduction of the items and maintaining them at this level until the items attain temperature stability.

After the temperature stability has been attained, the relative humidity shall be increased to not less than 95 percent within a period not exceeding 1 h while the chamber temperature is being maintained at $25 \pm 3^\circ\text{C}$.

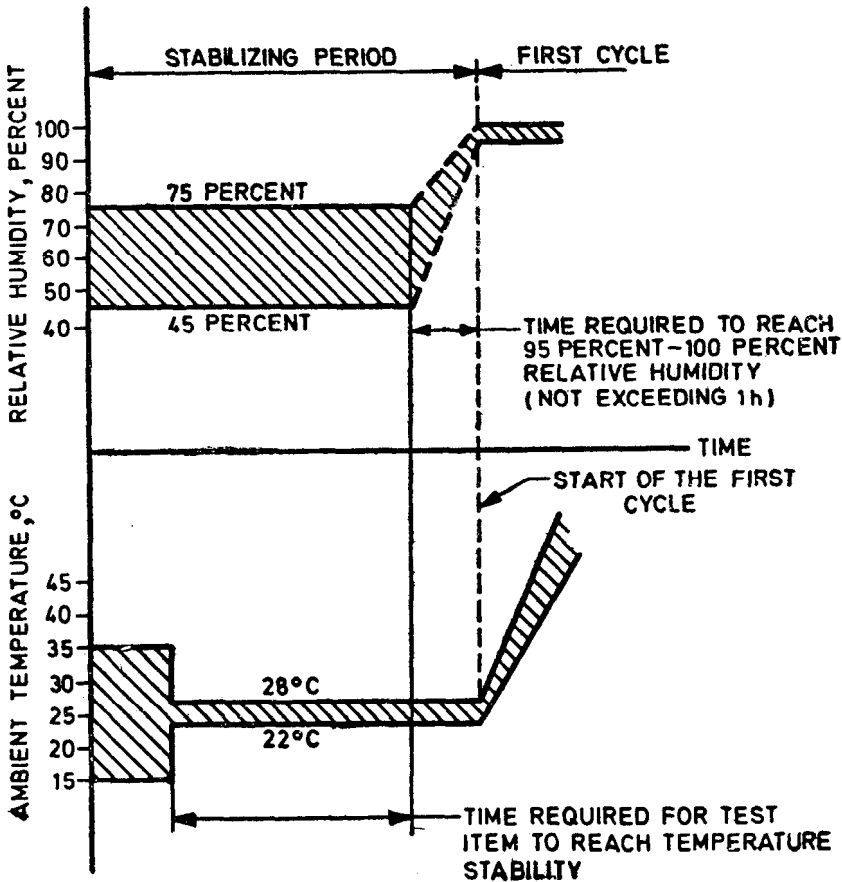


FIG. 2 STABILIZING PERIOD

7.3 Description of the 24-Hour Cycle — For the test cycle, two variants are given. The two variants are identical except for the temperature fall period of the test cycle where Variant 2 allows wider tolerances of relative humidity and temperature.

7.3.1 The temperature of the chamber shall be continuously raised to the appropriate upper temperature prescribed by the relevant specification. The upper temperature shall be achieved in a period of $3\text{ h} \pm 30\text{ min}$ and at a rate within the limits defined by the shaded areas in Fig. 1A and 1B. During this period, the relative humidity shall be not less than 95 percent, except during the last 15 min when it shall be not less than 90 percent. Condensation should occur on the item during the temperature-rise period.

NOTE — The condition that condensation should occur implies that the surface temperature of the item is below the dew point of the air in the chamber.

7.3.2 The temperature shall then be maintained within the prescribed limits for the upper temperature ($\pm 2^\circ$) until $16 \pm \frac{1}{2}\text{ h}$ from the start of the cycle. During this period, the relative humidity shall be 93 ± 3 percent except for the first and last 15 min when it shall be between 90 percent and 100 percent.

7.3.3 The temperature shall be lowered in accordance with one of the two variants given in 7.3.3.1 and 7.3.3.2.

7.3.3.1 Variant 1 — The temperature shall be lowered to $25 \pm 3^\circ\text{C}$ within 3 to 6 h (see Fig. 1A).

The rate of fall for the first one and a half hours shall be such that, if maintained as indicated in Fig. 1A, it would result in a temperature of $25 \pm 3^\circ\text{C}$ being attained in $3\text{ h} \pm 15\text{ min}$. The relative humidity shall be not less than 95 percent, except for the first 15 min when it shall be not less than 90 percent.

7.3.3.2 Variant 2 — The temperature shall be lowered to $25 \pm 3^\circ\text{C}$ within 3 to 6 h but without the additional requirement for the first hour and a half as in Variant 1. The relative humidity shall be not less than 80 percent (see Fig. 1B).

7.3.4 The temperature shall then be maintained at $25 \pm 3^\circ\text{C}$ with a relative humidity not less than 95 percent until the 24 h cycle is completed.

8. INTERMEDIATE MEASUREMENTS

8.1 The relevant specification may require electrical and/or mechanical checks during the conditioning programme.

8.2 If it is desired to make intermediate measurements, the relevant specification shall define the measurements and the period(s) during the conditioning after which they shall be carried out.

If required by the relevant specification, in case of severity 12, 21 and 56 cycles:

- a) the equipment type item shall be switched on and operated during the first 2 h of conditioning at the upper temperature of each 7th cycle.
- b) at the completion of each 7th cycle the equipment type item shall be visually examined and performance check shall be carried as specified.

NOTE — Measurements preceded by a recovery which will require removal of the items from the chamber are not permissible during the conditioning.

9. RECOVERY

9.1 If the item is such that closely controlled standard recovery conditions are not required, the relevant specification may prescribe recovery under the standard atmospheric conditions for testing for 1 to 2 h before final measurements (*see* 10).

Items having a large thermal time constant shall be submitted to recovery for a period sufficient to attain temperature stability.

The relevant specification shall state whether any special precautions shall be taken regarding the removal of surface moisture.

9.2 If the item under test is such that the relevant specification requires final measurements following closely controlled recovery conditions, the procedure given below shall be used.

At the end of the conditioning, the item shall be subjected to standard atmospheric conditions for recovery for 1 to 2 h (*see* Fig. 3).

Items having a large thermal time constant shall be submitted to recovery for a period sufficient to attain temperature stability.

The item may be transferred to another chamber for this recovery period or may remain in the damp heat chamber. In the former case the change-over time shall be as short as possible and not more than 10 min. In the latter case, the relative humidity shall be reduced to 75 ± 2 percent in not more than 30 min, after which the temperature shall be adjusted to laboratory temperature within $\pm 1^\circ\text{C}$ in not more than a further 30 min. For large items the relevant specification may allow longer changeover times.

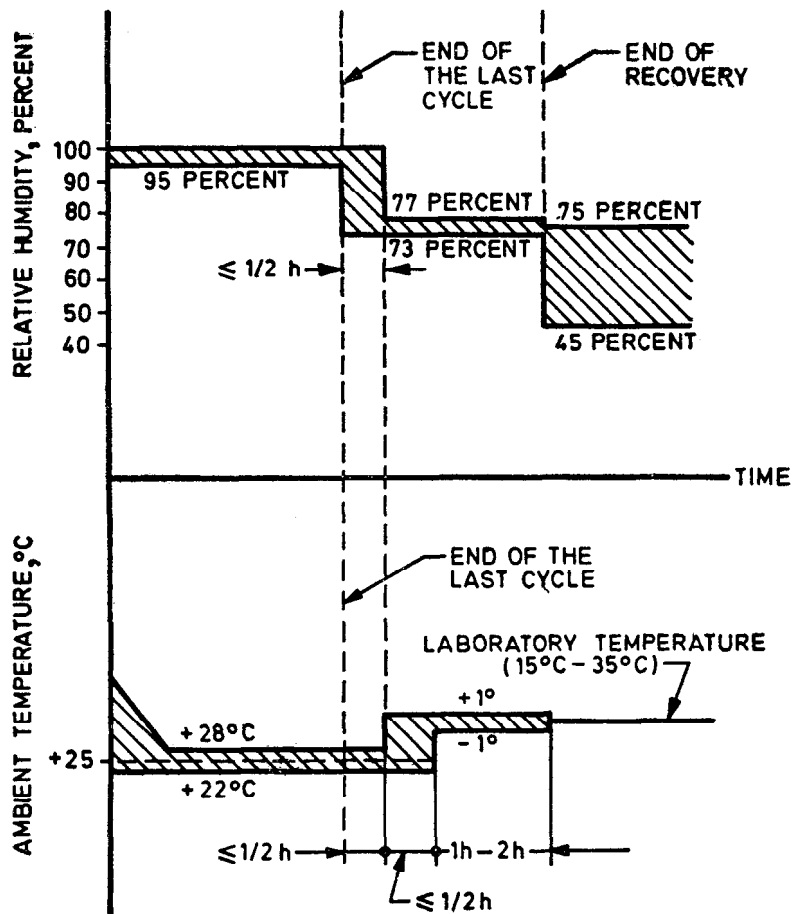


FIG. 3 RECOVERY AT CONTROLLED CONDITIONS

10. FINAL MEASUREMENTS

10.1 Equipment Type Items

10.1.1 The items shall be visually inspected, and electrically and mechanically checked as required by the relevant specification.

10.1.2 The measurements shall be commenced immediately after the recovery period and the parameters most sensitive to changes of relative humidity shall be measured first. Unless otherwise specified, the measurement of these parameters shall be completed within 30 min.

10.2 Component Type Items

10.2.1 Electrical and mechanical measurements may be made under any of the following conditions as required by the relevant specification:

- a) At high humidity,
- b) Immediately upon removal from the chamber, or
- c) After a drying period.

NOTE — It should be realized that many measurements taken under high humidity conditions are not directly comparable with those taken initially or after removal from the chamber.

10.2.2 *At High Humidity* — The measurements shall be made during the last 2 h of the final 24 h cycle.

10.2.2.1 The relevant specification shall specify the particular precautions to be followed in making measurements under conditions of high relative humidity, including the means to be adopted for the removal of surface water, if this is necessary.

10.2.2.2 The item shall be removed from the chamber after all measurements have been completed.

10.2.3 *Immediately Upon Removal from the Chamber* — On completion of the final cycle, the item shall be removed from the chamber and be kept at standard atmospheric conditions for testing.

10.2.3.1 If the initial measurements were made under conditions different from standard atmospheric conditions for testing, the same conditions shall be used for both sets of measurements.

10.2.3.2 Electrical and mechanical measurements as specified shall be made within a period of 1 to 2 h after removal from the chamber.

NOTE — Measurements taken early in this time period may be repeated once only, later in the time period. The later reading will be used for failure determination.

10.2.4 *After Drying Period* — On completion of the final cycle, the item shall be removed from the chamber and shall be kept under standard atmospheric conditions for testing, for a period of 24 h before the specified final measurements are made.

10.2.4.1 If the initial measurements were made under conditions other than standard atmospheric conditions for testing, the same conditions shall be used for both sets of measurements.

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10.2.4.2 Measurements may be made during the 24 h period, but only measurements made at the end of the 24 h period shall be used for failure determination.

11. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

11.1 When this test is included in the relevant specification, the following details shall be given as far as they are applicable:

<i>Details</i>	<i>Clause Ref</i>
a) Severity: temperature and number of cycles	5
b) Initial measurements	6
c) State of the item as introduced into the chamber	7.1
d) Details of mounting or supports	7.1
e) Variant 1 or 2	7.3.3
f) Intermediate measurements	8
g) Recovery conditions	9
h) Special precautions to be taken regarding removal of surface moisture	9.1
j) Electrical and mechanical checks to be made at the end of the test, the parameters to be measured first, and the maximum period allowed for the measurement of these parameters (final measurements)	10
k) Any deviation from the test procedure	—

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